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MEMORANDUM FOR THE RECORD

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Some Implications of the Integrated Emergency Program

Prepared For

The International Energy Review Group

25 June 1974
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Introduction

There are basically two models for attempts to prevent oil embargoes, and to mitigate damages of any embargo that does occur. Countries can take an entirely laissez-faire approach by letting market forces determine levels of oil stocks, consumption, imports, and prices. Alternatively, these variables might be managed according to an international agreement.

An agreement only to share oil during crises might dissuade producer countries from attempting selective embargoes, and might prevent price increases resulting from a scramble for available supplies. But such a limited agreement--if viewed as an insurance policy--could also reduce countries' incentives to legislate standby demand restraint programs and to increase emergency oil stocks. These negative effects might be countered by broadening the agreement to include management of stocks and demand.

Consideration of such a comprehensive agreement, or. Integrated Emergency Program (IEP), prompts the questions to be answered in this report:

-- During alternative embargoes that might have occured in 1974, what levels of imports would an IEP have allowed the US, Western Europe, and Japan?

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-- How much oil would an IEP now require the US to add to its stocks?

-- Under an IEP, how long would US oil stocks have lasted if certain crises had occurred in 1974?

-- In terms of stock requirements and imports allowed during crises, how would the US and other major oil importers fare under an IEP in 1985?

-- In relation to an IEP, how would certain agreements only on sharing affect US imports during embargoes?

-- What effects would an IEP have on consumer countries' incentives to reduce their dependence on oil imports?

To answer these questions, we first posit a particular IEP, and examine its implications for oil imports and stocks. We then consider effects of variations in the agreement.

<u>Details of the IEP</u>

The US, Western Europe, and Japan might now agree that each will maintain an oil stock equivalent to 100 days of normal imports, will restrain oil consumption by at most 10% during any crisis, and will adhere to a sharing plan.

The sharing plan distinguishes among severe, moderate, mild, and negligible crises. During severe crises, where oil supplies are reduced by an amount exceeding 10% of the partner countries' combined normal consumption, imports are determined

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according to a principle that each partner should exhaust its agreed oil stock over the same time while maintaining consumption at 90% of normal.

To develop from this principle a formula for allocating imports during severe crises, we define $\underline{C}$ as the partners' combined daily rate of oil consumption immediately before a crisis, so that restrained consumption is $.90\underline{C}$. If $\underline{P}$ denotes the partners' combined oil production just prior to the crisis, and if $\underline{I}$ measures the total daily rate of imports available to the partners during the crisis, then the supply shortfall $\underline{S}$ becomes

$$S = .90C - P - I.$$

This means that the partners as a group draw from their stocks $\underline{S}$ million barrels of oil per day (mb/d).

This shortfall is allocated among partners in proportion to their agreed oil stocks. If t_j measures the $\underline{jth}$ partner's stock, and $\underline{T}$ is the total stock, then the $\underline{jth}$ partner's daily stock drawdown obligation d_j becomes

$$d_j = (t_j/T)S.$$

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When each partner depletes its required stock at the agreed rate, then each exhausts that stock at the same time.

To determine the intra-crisis imports allowed to each partner, we define c_j as the $j\underline{th}$ partner's daily oil consumption just before the crisis, and p_j as the partner's pre-crisis daily oil production. The imports the partner needs to maintain its restrained rate of consumption are n_j, where

$$n_j = .90c_j - p_j.$$

The imports that the partner actually gets during the crisis are then i_j, where

$$i_j = n_j - d_j.$$

This says that a partner's allowed imports during a severe crisis equal his required imports minus his drawdown obligation.

During moderate crises, in which a 10% demand restraint would overcompensate the embargo loss, the percentage of demand restraint is set just large enough to make the combined shortfall zero. There are no stock drawdown obligations, and each partner receives imports equal to the difference between

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restrained consumption and normal production.

A crisis may be small enough not to warrant demand restraints. During a mild embargo, in which the partners suffer a combined loss of less than 5% of their normal consumption, demand restraints are set at zero, so the total shortfall becomes

$$S = C - P - I,$$

which means that the shortfall is the combined loss. The loss is compensated by stock drawdowns, which are determined as in severe crises. Thus during mild crises the partners share oil and draw from their stocks, but do not restrain consumption.

During negligible crises, when a selective embargo forces no partner to take more than a 5% loss in imports, there is no required demand restraint and no sharing. Partners take their own steps to deal with negligible crises.

In summary, the four kinds of crises cover all possible losses. The apportionment scheme therefore anticipates any supply disruption.

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Effects of the IEP

Had different embargoes occurred in 1974, partners in the IEP would have suffered the combined losses shown in Table 1. During any embargo, the IEP would have dictated larger percentage cuts in imports for the US than for other partners (see Tables 1 and 2). Allowed US imports, however, do not vary smoothly as a function of the total imports available to the group (see Figure 1). The break points in the function stem from the distinctions the IEP draws among crises of different severity.

During the embargoes, agreed stocks would last at least a half year (see Table 3). Because the IEP distinguishes among crises of different severity, stocks last longer in some crises that are more severe than others. This paradoxical result is unimportant, however, since stocks last virtually forever during moderate embargoes.

To meet the agreed stock level for 1974, the US would have to store an additional 29 million barrels of oil.* At $10/b for the oil itself, and at $5/b for storage construction, the cost is roughly half a billion dollars. An increase of storage construction costs to $10/b would increase the total cost by $150 million.

The IEP effect on imports changes significantly over time. Recent OECD forecasts indicate that should the price per barrel of oil remain at $9, the US would import only .012 mb/d in 1985, versus 6.2 mb/d in 1974. Thus the IEP

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* We have defined US emergency stocks to be 60% of total US stocks as reported by the American Petroleum Institute.

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Table 1
Oil Imports the IEP Would Allow During Embargoes in 1974
(in millions of barrels per day and in percent of normal imports)

Embargo	Total Imports Available* (mb/d)	(%)	United States (mb/d)	(%)	Western Europe (mb/d)	(%)	Japan (mb/d)	(%)
100% OPEC minus Iran	7.20	27	0.80	13	4.71	31	1.69	31
100% OAPEC	12.20	46	1.96	32	7.55	50	2.70	50
50% OPEC	14.80	55	2.56	41	9.02	59	3.22	60
100% OAPEC minus Saudi Arabia	18.00	67	3.30	53	10.84	71	3.87	72
50% OAPEC	19.50	73	3.64	59	11.69	77	4.17	77
100% OAPEC against the US, West Germany, and the Netherlands	22.30	83	4.29	69	13.28	87	4.73	88
25% OAPEC	23.20	87	4.56	74	13.74	90	4.90	91
100% OAPEC against the US	25.20	94	5.83	94	14.29	94	5.08	94

* Total imports available to the US, Western Europe, and Japan.

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Table 2
Oil Imports the IEP Would Allow During Embargoes in 1974
(in millions of barrels per day and in percent of normal imports)

Embargo	Total Imports Available* (mb/d)	(%)	France (mb/d)	(%)	West Germany (mb/d)	(%)	United Kingdom (mb/d)	(%)	Italy (mb/d)	(%)
100% OPEC minus Iran	7.20	27	0.87	31	0.69	31	0.73	31	0.76	31
100% OAPEC	12.20	46	1.39	50	1.11	49	1.16	50	1.22	5.
50% OPEC	14.80	55	1.66	60	1.33	59	1.39	60	1.46	60
100% OAPEC minus Saudi Arabia	18.00	67	1.99	71	1.60	71	1.67	72	1.75	72
50% OAPEC	19.50	73	2.14	77	1.72	77	1.80	77	1.88	77
100% OAPEC against the US, West Germany, and the Netherlands	22.30	83	2.43	88	1.96	87	2.04	88	2.14	88
25% OAPEC	23.20	87	2.52	91	2.03	90	2.11	91	2.21	91
100% OAPEC against the US	25.20	94	2.61	94	2.12	94	2.19	94	2.29	94

* Total imports available to the US, Western Europe, and Japan.

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Figure 1
Oil Imports the IEP Would Allow
During Embargoes in 1974*

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Percentage
of Normal
Imports
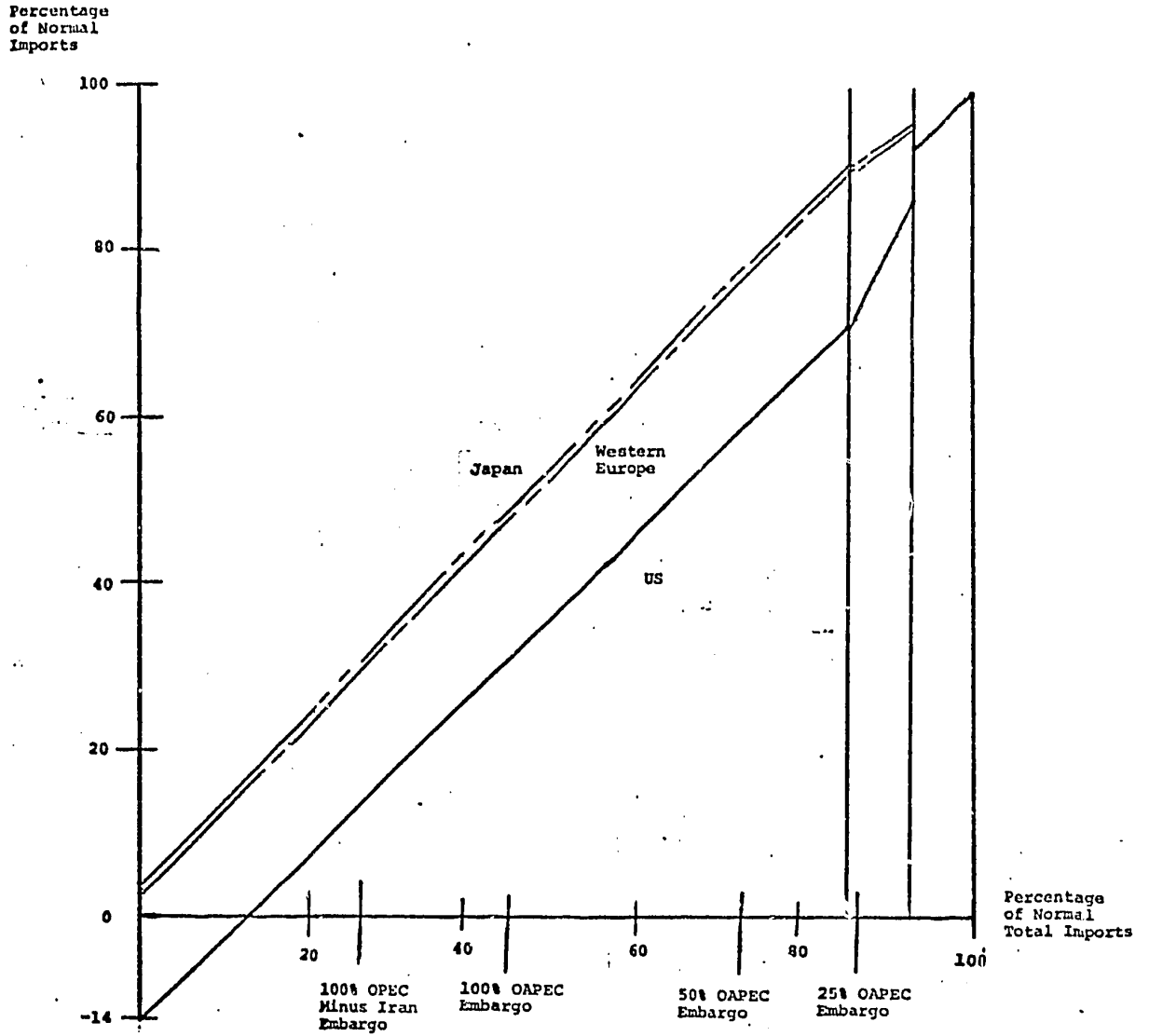
* The US, Western Europe, and Japan each lose roughly
the same percentage of imports when their combined
loss is less than 7% of their normal imports.

Table 3
Days that Agreed Oil Stocks Would Last
During Embargoes in 1974

Embargo	Available Imports* (mb/d)	Percentage of Normal Imports Available	Days that Stocks Last
100% OPEC minus Iran	7.2	27	170
100% OAPEC	12.2	46	250
50% OPEC	14.8	55	329
100% OAPEC minus Saudi Arabia	18.0	67	543
50% OAPEC	19.5	73	780
100% OAPEC against the US, West Germany, and the Netherlands	22.3	83	4222
25% OAPEC	23.2	87	∞
100% OAPEC against the US	25.2	94	1675

* Total imports available to the US, Western Europe, and Japan.

would in 1985 force the US to export domestic production
in almost all crises (see Table 4 and Figure 2).

Agreed stocks in 1985 would last at least a half year, and
probably much longer (see Table 5). Changes in import patterns
account for the stock life differences between 1974 and 1985.

Effects of Changes in the IEP

Parameters of the IEP, notably stock requirements and
demand restraints, can be changed without altering the
agreement's basic structure. In particular, agreed stocks
can be those required to maintain 90% rather than 100%
of normal oil consumption for 100 days without imports.

Effects of this change, in terms of allowed imports,
are negligible for moderate crises (compare Tables 1 and 6).
In severe crises the US fares slightly better. Moreover,
the change has little effect on stock lives during crises
(compare Tables 3 and 7). The change does, however, allow
the US to meet the stock requirement with present stocks.

Under an additional modification of the IEP, each
partner agrees to restrain oil demand during severe crises
by an amount equal to 5% of total energy consumption, rather
than 10% of oil consumption. Since oil accounts for a
different fraction of each partner's energy consumption,
the change means that each partner agrees to a different
demand restraint as a percent of oil consumption.

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Table 4
Oil Imports the ..:P Would Allow During Embargoes in 1985
(in millions of barrels per day and in percent of normal imports)

Embargo	Total Imports Available* (mb/d)	(%)	United States (mb/d)	(%)	Western Europe (mb/d)	(%)	Japan (mb/d)	(%)
100% OPEC minus Iran	5.80	27	-1.68	-14014	4.41	34	3.08	36
100% OAPEC	10.10	47	-1.68	-13994	7.00	53	4.78	56
50% OPEC	12.10	56	-1.68	-13985	8.21	63	5.57	65
100% OAPEC minus Saudi Arabia	14.00	68	-1.68	-13972	9.83	75	6.64	77
50% OAPEC	15.90	73	-1.68	-13968	10.50	80	7.08	82
100% OAPEC against the US, West Germany, and the Netherlands	19.60	90	-0.84	- 6979	12.28	94	8.16	95
25% OAPEC	18.80	87	-1.16	- 9675	11.97	91	7.99	93

* Total imports available to the US, Western Europe, and Japan.

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Figure 2
Imports the IEP Would Allow During
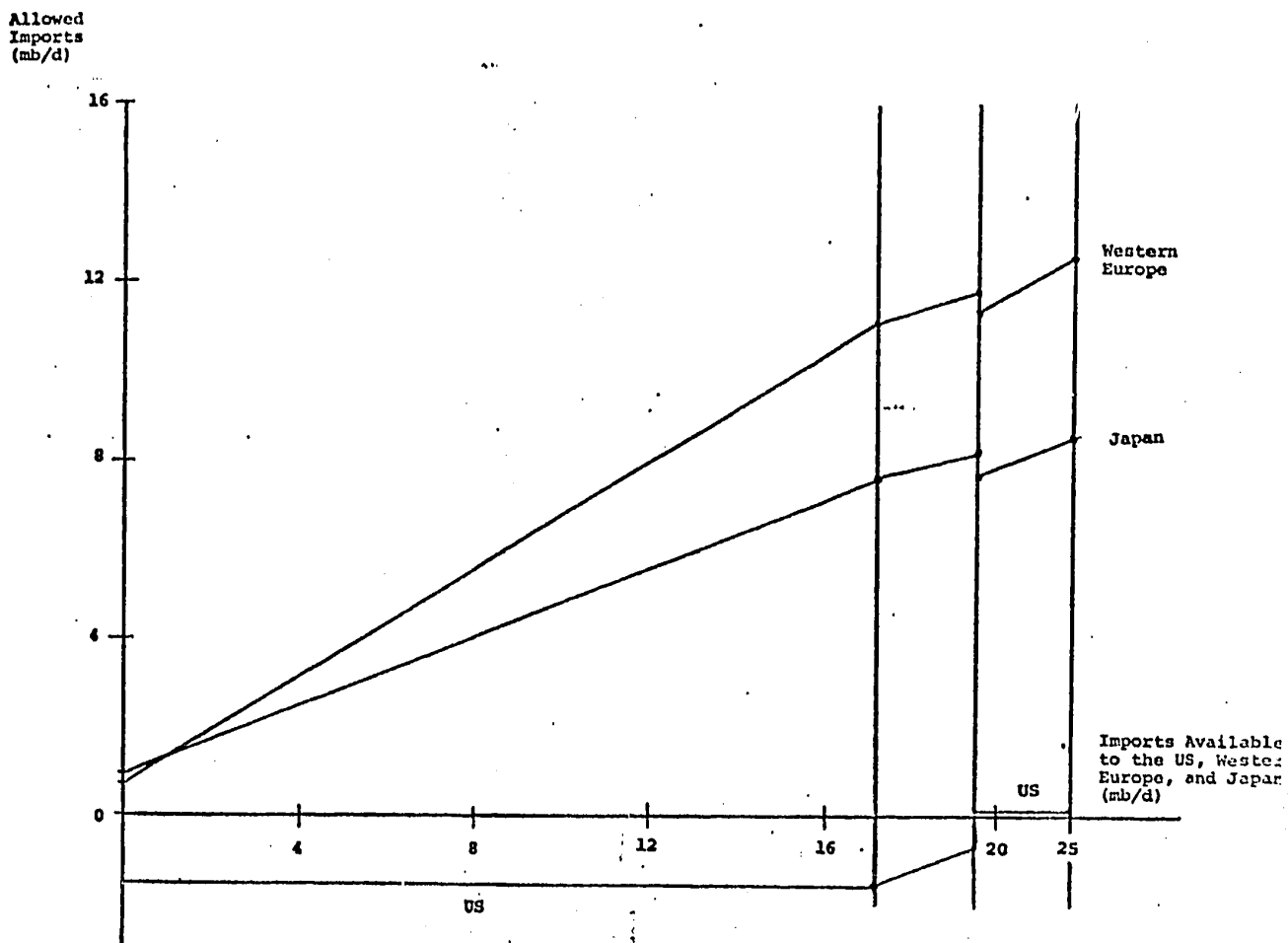Embargoes in 1985
(in millions of barrels per day)

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Table 5
Days that Agreed Oil Stocks Would Last
During Embargoes in 1985

Embargoes	Available Imports* (mb/d)	Percentage of Normal Imports Available	Days that Stocks Last
100% OPEC minus Iran	5.8	27	185
100% OAPEC	10.1	47	292
50% OPEC	12.1	56	400.
100% OAPEC minus Saudi Arabia	14.8	68	795
50% OAPEC	15.9	73	1332
100% OAPEC against the US, West Germany, and the Netherlands	18.8	87	∞
25% OAPEC	19.6	90	∞

* Total imports available to the US, Western Europe, and Japan.

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Table 6
Oil Imports the IEP* Would Allow During Embargoes in 1974

Embargo	Total Imports Available** (mb/d)	(%)	United States (mb/d)	(%)	Western Europe (mb/d)	(%)	Japan (mb/d)	(%)
100% OPEC minus Iran	7.20	27	1.39	22	4.28	28	1.53	28
100% OAPEC	12.20	46	2.36	38	7.25	48	2.59	48
50% OPEC	14.80	55	2.86	46	8.80	58	3.14	53
100% OAPEC minus Saudi Arabia	18.00	67	3.48	56	10.70	70	3.81	71
50% OAPEC	19.50	73	3.77	61	11.59	76	4.13	77
100% OAPEC against the US, West Germany, and the Netherlands	22.30	83	4.32	70	13.26	87	4.73	88
25% OAPEC	23.20	87	4.56	74	13.74	90	4.90	91
100% OAPEC against the US	25.20	94	5.89	95	14.25	94	5.06	94

* In this version of the IEP, agreed stocks are those necessary to maintain 90% of normal consumption for 100 days without imports.
** Total imports available to the US, Western Europe, and Japan.

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Table 7
Days that Agreed Oil Stocks* Would Last
During Embargoes in 1974

Embargo	Available Imports** (mb/d)	Percentage of Normal Imports Available	Days that Stocks Last
100% OPEC minus Iran	7.2	27	146
100% OAPEC	12.2	46	214
50% OPEC	14.8	55	282
100% OAPEC minus Saudi Arabia	13.0	67	465
50% OAPEC	19.5	73	668
100% OAPEC against the US, West Germany, and the Netherlands	22.3	83	3613
25% OAPEC	23.2	87	∞
100% OAPEC against the US	25.2	94	1433

*   Agreed stocks are those necessary to maintain 90% of normal consumption for 100 days without imports.
** Total imports available to the US, Western Europe, and Japan.

The two changes regarding agreed stocks and demand restraints cause negligible differences in imports allowed the US (compare Tables 1 and 8). Stock lives are similarly unchanged (compare Tables 3 and 9).

Further parameter changes, however, would significantly alter the US standing during crises. In general, increases in the agreed percent of demand restraint decrease the intra-crisis imports allowed to the US. In 1974, for example, each percentage point increase in the demand restraint (stated as 10% of oil consumption) costs the US 86,700 b/d in allowed imports. This loss does not vary with the level of severe crises.

Comparisons with Agreements Only on Sharing

Under one alternative to the IEP apportionment plan, partners each take the same percentage cut in oil imports in order to share an embargo loss. This import-based scheme always allows the US more intra-crisis imports than does consumption-based sharing, in which partners apportion a loss by taking equal percentage cuts in oil consumption. Under the IEP, the US fares worse than under import-based sharing, but better than under the consumption basis (see Table 10).

A third alternative to the IEP has been advocated by Japanese delegates to the OECD. Their plan is essentially an arithmetic compromise between sharing on the basis of consumption versus imports. For example, to weight consumption-based sharing by 90%, one multiplies each partner's

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Table 8
Oil Imports the IEP* Would Allow During Embargoes in 1974

Embargo	Total Imports Available** (mb/d)	(%)	United States (mb/d)	(%)	Western Europe (mb/d)	(%)	Japan (mb/d)	(%)
100% OPEC minus Iran	7.20	27	1.37	22	4.29	28	1.55	29
100% OAPEC	12.20	46	2.32	37	7.26	48	2.62	49
50% OPEC	14.80	55	2.81	45	8.81	58	3.18	59
100% OAPEC minus Saudi Arabia	18.00	67	3.42	55	10.71	70	3.87	72
50% OAPEC	19.50	73	3.70	60	11.61	76	4.19	78
100% OAPEC against the US, West Germany, and the Netherlands	22.30	83	4.23	68	13.27	87	4.79	89
25% OAPEC	23.57	88	4.47	72	14.03	92	5.07	94
100% OAPEC against the US	25.20	94	5.90	95	14.25	94	5.06	94

* In this version of the IEP, demand restraints are 5% of total energy consumption, rather than 10% of total oil consumption. Agreed stocks are those necessary to maintain restrained consumption for 100 days without imports.

** Imports available to the US, Western Europe, and Japan.

Table 9
Days that Agreed Oil Stocks* Would Last
During Embargoes in 1974

Embargoes	Available Imports** (mb/d)	Percentage of Normal Imports Available	Days that Stocks Last
100% OPEC minus Iran	7.2	27	144.
100% OAPEC	12.2	46	207
50% OPEC	14.8	55	269
100% OAPEC minus Saudi Arabia	18.0	67	423
50% OAPEC	19.5	73	579
100% OAPEC against the US, West Germany, and the Netherlands	22.3	83	1854
25% OAPEC	23.2	87	6352
100% OAPEC against the US	25.2	94	1473

* Agreed stocks are those necessary to allow consumption (restrained by 5% of energy demand) for 100 days without imports.
** Imports available to the US, Western Europe, and Japan.

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Table 10
A Comparison of Imports Allowed the US Under
the IEP, Consumption-Based Sharing, and Import-Based Sharing
During Embargoes in 1974
(in millions of barrels per day and in percentage of normal imports)

Embargo	Imports Available* (mb/d)	(%)	US Imports Under the IEP (mb/d)	(%)	US Imports Under Consumption-Based Sharing (mb/d)	(%)	US Imports Under Import-Based Sharing (mb/d)	(%)
100% OPEC minus Iran	7.20	27	0.80	13	-2.73	-44	1.67	27
100% OAPEC	12.20	46	1.96	32	-0.45	- 7	2.82	46
50% OPEC	14.80	55	2.56	41	0.73	12	3.42	55
100% OAPEC minus Saudi Arabia	18.00	67	3.30	53	2.19	35	4.16	67
50% OAPEC	19.50	73	3.64	59	2.87	46	4.51	73
100% OAPEC against the US, West Germany, and and the Netherlands	22.30	83	4.29	69	4.15	67	5.16	83
25% OAPEC	23.20	87	4.56	74	4.56	74	5.37	87
100% OAPEC against the US	25.20	94	5.83	94	5.47	88	5.83	94

* Imports available to the US, Western Europe, and Japan.

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consumption-based share by .90, and then multiplies each

import-based share by .10. Each partner's compromise share

is the sum of his weighted shares. The Japanese prefer to

weight the consumption basis as heavily as other partners

agree. Thus the US would probably fare worse under the

Japanese plan than under the IEP.

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Incentives to Reduce Dependence on Imports

Each sharing agreement we have considered penalizes attempts by partner countries to reduce their dependence on oil imports. To illustrate this, we consider two hypothetical historical scenarios:

Scenario 1: In 1974 the US does nothing more than it actually did to reduce its dependence on oil imports. Later in 1974, OAPEC stops 50% of its exports to the US, Western Europe, and Japan.

Scenario 2: In 1974 the US increases its domestic oil production enough to reduce its oil imports by 25%, in contrast to the first scenario. Later in 1974--as in the first scenario--OAPEC stops 50% of its exports to the US, Western Europe, and Japan.

Had certain sharing agreements been in force during 1974, the US would have been allowed fewer intra-crisis imports in the second versus the first scenario. In this sense, each sharing plan would have penalized the US. The penalty that each plan levies is the difference in the intra-crisis imports allowed the US under the two scenarios.

In particular, the US penalty would have been 1.30 mb/d under the basic IEP, 1.34 mb/d under consumption-based sharing, and 1.12 mb/d under import-based sharing. Thus under the IEP,

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had the US reduced its imports by 25% or 1.55 mb/d, it would have bettered its standing during the crisis by .25 mb/d. The corresponding gain under import-based sharing would have been .43 mb/d. Thus import-based sharing provides a greater incentive to reduce dependence on imports. This holds true for countries other than the US, even when a partner reduces its imports by cutting oil consumption.

The penalties imposed by import-based sharing could be eliminated by a slight change in this plan. Specifically, normal future imports could be projected for each partner. Then during a crisis, the supply loss could be allocated in proportion to projected rather than actual imports. This solution could be constrained by a stipulation that no partner would gain actual imports as a result of sharing.

The IEP could similarly be modified to soften the penalties it imposes on countries' attempts to reduce dependence on imports. The modification would link a partner's agreed oil demand restraint to the partner's reduction in imports below some norm. Thus as the US approaches independence of oil imports, US shares of intra-crisis imports would increase.

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Summary

The IEP apportionment plan represents a middle ground between import-based sharing (under which the US would fare best during embargoes) and consumption-based sharing. As the US reduces its dependence on oil imports, both the IEP and consumption-based sharing become burdens to the US. All three plans impose certain penalities on countries' efforts .to reduce import dependence, but simple changes in the IEP and in import-based sharing could soften these penalties.